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January 23, 1913.

The food of the Robin.

By

E. V. Wiley.

C Crane flies (Tipulidae) as food of the Robin.

By

F. M. Webster.

THE FOOD OF THE ROBIN.

BY E. V. WILCOX.

The economic relations of birds is a subject which, until recent years, has received very little serious attention. Different species of birds have been classed as beneficial or injurious from mere conjecture or sentimental considerations. We are often told that the small amount of fruit taken by fruit-eating species is more than counterbalanced by the great numbers of insects destroyed by these same birds. Now, while for certain purposes it may be admissible to include in a bird's economic relations its æsthetic value, the present consideration of the subject is from a strictly utilitarian point of view.

But before giving a record of my own work upon the feeding habits of the robin I shall make a brief synopsis of work done by others in this particular field of investigation.

Prof. S. A. Forbes, in Vol. I, No 3, of Bulletin Illinois State Laboratory of Natural History, has published a report of a careful investigation of the food of the robin, based upon the examination of one hundred and fourteen stomachs. Prof. Forbes has tabulated his results as follows :

- I. Mollusca, 1 per cent. of food for one month in 1 stomach.
- II. Insecta, 65 per cent. of food for whole year in 107 stomachs.
 1. Hymenoptera, 4 per cent. of food for whole year in 41 stomachs.
 2. Lepidoptera (larvæ), 17 per cent of food for whole year in 56 stomachs.
Noctuidæ, 8 per cent. of food for whole year in 23 stomachs.
 3. Diptera, 17 per cent. of food for whole year in 28 stomachs.
Bibionidæ, 15 per cent. of food for whole year in 18 stomachs.
 4. Coleoptera, 18 per cent. of food for whole year in 81 stomachs.
Carabidæ, 5 per cent. of food for whole year in 47 stomachs.
Scarabæidæ, 7 per cent. of food for whole year in 40 stomachs.
Lachnosterna, 3 per cent. of food for whole year in 10 stomachs.
Elateridæ, 2 per cent. of food for whole year in 20 stomachs.
Rhynchophora, 2 per cent. of food for whole year in 30 stomachs.
 5. Hemiptera, 3 per cent. of food for year in 35 stomachs.
 6. Orthoptera, 4 per cent of food for year in 26 stomachs.
- III. Arachnida, 1 per cent. of food for year in 13 stomachs.
- IV. Myriapoda, 8 stomachs.
- V. Earth-worms, 2 stomachs.
- VI. Fruits and seeds, 34 per cent. of food for year in 65 stomachs.
Blackberries, 7 per cent. of food for year in 12 stomachs.
Raspberries, 2 per cent of food for year in 4 stomachs.
Cherries, 11 per cent. of food for year in 24 stomachs.
Currants, 2 per cent. of food for year in 6 stomachs.
Grapes, 7 per cent. of food for year in 10 stomachs.
Mountain Ash, 1 per cent. of food for year in 2 stomachs.
Sumach, 1 per cent. of food for year in 5 stomachs.

Species.	Percentages for each month.								General ratios.
	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	
Beneficial.....	5	6	21	9	64	85	50	57	36
Injurious	94	74	47	55	24	10	31	7	43
Neutral.....	1	20	82	36	12	5	19	36	21

The figures in the table speak for themselves, and Prof. Forbes' general conclusion as stated in his own language is: "I do not believe that the horticulturist can sell his small fruits anywhere in the ordinary markets of the world at so high a price as to the robin, provided that he uses proper diligence that the little huckster doesn't over-reach him in the bargain. In other words, while the bird is far too valuable to exterminate, at least until we are sure we can replace him by some cheaper assistant, yet he is not so precious that we need hesitate to protect our fruits from outrageous injury. Indeed it seems likely that the ordinary destruction of robins by gardeners does not more than compensate for the destruction of birds of prey in the interests of the poultry yard—removing that excess of robins which, in the more natural order, would fall victims to the hawks and owls."

These conclusions are cautious and certainly within the bounds of the experimental data upon which they are based. The results arrived at are founded upon a thorough and painstaking examination of one hundred and fourteen stomachs, and, coming from a man of such known standing as Professor Forbes, challenge our attention.

In Vol. I of the Wisconsin Geological Survey, Mr. F. H. King devotes a small portion of a paper on the "Economic Relations of Wisconsin Birds" to a consideration of the robin. Thirty-seven stomachs were examined.

Animal food was found in 34 stomachs.

Vegetal food was found in 13 stomachs.

Adult forms, 16 were found in 24 stomachs.

Pupæ, 6 were found in 2 stomachs.

Larvæ, 49 were found in 19 stomachs.

Insect eggs, 9 were found in 2 stomachs.

Hymenoptera, 14 were found in 3 stomachs.

Lepidoptera, 26 were found in 13 stomachs.

Coleoptera, 53 were found in 19 stomachs.

Orthoptera, 9 were found in 6 stomachs.

Spiders, 2 were found in 2 stomachs.

Myriapods, 1 was found in 1 stomach.

Earthworms, 2 were found in 2 stomachs.

Detrimental species, 60 were found in 29 stomachs.

Beneficial species, 10 were found in 6 stomachs.

Unknown species, 56 were found in 17 stomachs.

The conclusions at which this gentleman arrives are very favorable for the robin. He says, "in its method of obtaining food and in the situation from which its food is gleaned, the robin performs a very important work, and one for which few other birds are so well adapted. So important is this work that the quantity of small fruits which it consumes is but a stingy compensation for the service which it renders, and I know of no bird whose greater abundance is likely to prove of more service to the country. Its eminently terrestrial habits, its fondness for larvæ of various kinds, and its ability to obtain those which are hid en beneath the turf, give it a usefulness in destroying cutworms in the larval state, which no other bird possesses in the same degree, and for this feature of its economy alone its greater abundance should be encouraged."

The author seems to me to draw his conclusions a little too confidently, considering that they are based on the examination of only thirty-seven stomachs. Moreover, he himself states elsewhere in the same paper that we can not conclude that a bird is beneficial or injurious in a general sense from the fact that they possess one particular good or bad habit, and in this connection he instances the case of the Bobolink, whose habits at the South have earned him the bad name of Rice Bird, while with us he is almost wholly insectivorous. Just as we would err in concluding that the Bobolink should be destroyed because of its rice-eating propensities, so would we err in concluding that a greater abundance of the Robin should be encouraged in consequence of his destruction of cutworms. In short, the criticism which I have to offer upon that part of Mr. King's paper which relates to the robin is not on the work done, but on the conclusions drawn from that work. I can not believe that such far-reaching generalizations are safely based on the examination of so small a number of robins.

It may be of interest to add some general statements as to the robin's food by other authors:

"Its principal food is berries, worms and caterpillars; berries, those of the sour gum and poke berry" (Wilson); "Chiefly insects—especially worms—and berries" (Cooper); "Worms, insects, berries and fruits" (DeKay); "Grubs and caterpillars, crickets, grasshoppers, grubs of locusts,

harvest flies, and of beetles, the apple-worm when it leaves the apple, cut-worms, silk-worms" (Samuels); "Larvæ of *Bibionidæ*" (Packard); "Larvæ of *Dryocampa senatoria*" (A. J. Cook). Glover also makes a plea for the robin, stating that as many as two hundred larvæ of *Bibio albipennis* have been taken from the stomach of a single robin. (Rept. Com. Agriculture for 1864, p. 441.) But as this species of insect is no longer considered injurious, the acknowledged great destruction of it brings no credit to the robin.

Having now given a very incomplete synopsis of the work heretofore done on the feeding habits of the robin, I may proceed to an exposition of my own work upon this subject. The work was undertaken at the request of the Horticulturist of this Station, Mr W. J. Green, and has occupied about one-third of my time during the season since April 1. I have not allowed more than five consecutive days during this time to pass by without killing one or more robins, sometimes as high as five or six per day, but averaging a little more than one per day. The great majority of the birds were killed on the Station grounds, about fifty being taken in other parts of the State. The stomach of each robin was removed while fresh, and the contents were at once placed in vials containing alcohol to preserve them in good order for future examination. The contents of each stomach were put in a separate vial.

I have taken as great care as possible in the examinations of the food materials, sometimes spending three or four hours upon a single stomach. For any errors in identification which there may be, I am, of course, responsible. The determination of insect remains in the stomachs of birds is a very difficult and perplexing task, and one which is not at all pleasant, since nearly all the material is in the very worst condition imaginable, and mutilated and partly digested fragments of several species of insects being mixed up in utter confusion. The elytra, mouth parts and tarsi of beetles are, of course, usually left to tell their tales, as are also the harder parts of all other insects, snails, myriapods and the seeds of the various fruits; but the soft bodied larvæ and earth-worms are too often macerated almost beyond recognition.

How to estimate the relative proportions of the various food matters found in the stomachs examined is a very important but rather difficult question. Upon a slight consideration it becomes evident that we can not base our proportions upon the relative bulk of different materials. To illustrate, suppose we place on one side of the equation a blackberry and on the other enough chinch bugs to equal the bulk of the berry. It would obviously be very absurd to assume that the one counterbalances the other. Mr. King, in the article referred to, has considered this difficulty in the following words:

"If we compare the corn plant-louse, the gall stage of the grape phylloxera, the plum curculio, the small parasitic military microgaster, which lays its eggs in several kinds of cut-worms, the potato beetle and the chinch-bug with the large coral-winged grasshopper, bulk for bulk, the ratios will appear about as follows:

1	Coral-winged grasshopper	=12,000 military microgasters.
1	"	" =3,000 phylloxera.
1	"	" =1,500 corn-plant lice.
1	"	" =750 chinch bugs.
1	"	" =60 plum curculios.
1	"	" =7 potato beetles.
1	"	" =1,000 young potato beetles.

"By a system of gauging bulk for bulk it is evident from the table that one coral-winged grasshopper eaten by a bird would give it a credit which would affect completely the destruction of 12,000 military microgasters, a proposition sufficiently absurd."

Having seen from the start that the ratios of the different food materials could not justly be estimated according to bulk, and having seen also that a system based upon the number of insects, plant fruits, etc., found in the stomachs examined would be almost equally likely to introduce error, and that it would be a system particularly difficult to carry out in consequence of the fragmentary condition of the food, I decided to combine these two systems of computing the proportions in a way which seems to me to represent justly all the elements of food. It would be approximately true to say that I have estimated the proportion of animal food according to the number of the individuals, and vegetal food according to bulk. But all fruits which have a definite number of seeds have been estimated upon a numerical basis. It is evident that this would have been very difficult or even impossible in the case of blackberries or raspberries in which the number of seeds is so variable.

It may be objected that the computation of the vegetable food on one basis and of the animal food upon another basis is a fruitful source of error. But I have exercised all care and diligence to avoid every possibility of error, and, in fact, an estimation of the relative proportions of the several kinds of food would not make the vegetal part appear larger than it really is, since a raspberry or blackberry is no greater in bulk than an earthworm or May beetle. It may as well be admitted that, in the present state of knowledge, only an approximation to the truth can be attained in a statement of the relative proportion of the various food materials in a bird diet.

But even after we have tabulated the numerous articles of food in their differing proportions in a more or less satisfactory manner, the task is by no means completed. In order that we may decide whether the robin is on the whole a benefit or an injury to farmers and gardeners, we must first determine the economic relations of the various species of plants

and animals upon which the robin feeds. When the robin takes our cherries and other small fruits, we know that he does us an injury. When he destroys cut-worms and May beetles (*Lachnosterna*), he is a benefit to us, but when he feeds upon insects, the life history and economic relations of which are unknown or in dispute, the case becomes very different. I have followed the economic classification adopted by Prof. Forbes, who classes all food matters as beneficial, injurious or neutral. By the term neutral I would not be understood to affirm that there is any organism in this world whose life does not in some way affect us. It serves only as a measure of our ignorance, and indicates that the life history of too many plants and animals is so incompletely known that we must provisionally class them as neutral, the knowledge failing us necessary to place them as positively injurious or beneficial. There is, however, little danger that increase of knowledge on this point will seriously affect the proportions as tabulated in the following discussion.

The robin usually winters in small numbers in some parts of Ohio, but the great majority are migrant and reappear at the central part of the State during the last of February or the first of March. This year there was a large flock (about 100) on the Station grounds by March 5th. After this date there were two weeks of cold weather with considerable snow, during which time the robin fed almost exclusively upon the asparagus bed, the berries of which were still in good condition. The stomach of a single robin shot at this time contained 60 seeds of asparagus.

Apri.—Sixty robins were shot during this month, an average of two per day, and at least one every day, Sundays excepted. All the vegetable food contained in these stomachs consisted of two seeds of a grass (*Elymus*) and one akene of a *Polygonum*. These were probably taken incidentally in securing other food. The Carabid larvæ found in stomachs during this month were no doubt taken from rotten wood. I found the same species in such places along with elaterid larvæ, and noticed robins digging with their beaks in the rotten wood and leaf mould. Having shot them under such conditions, I found carabid larvæ in a fresh state in their stomachs. About the middle of the month *Agonoderus pallipes* was present in immense numbers. Species of *Melanotus* (adults of wire worms) could also be seen in considerable numbers flying or running on the ground, but these were evidently too active for the robin to secure very plentifully. The large percentage of *Aphodius* found in stomachs during April is explained by the fact that they (species of *Aphodius*) were very abundant in decaying turnips in the Station gardens. This genus furnishes several quite useful scavengers, though the most of them infest the droppings of cattle, etc.

The general summary of these examinations in accordance with principles already explained gives:

Vegetable, $\frac{2}{3}$ per cent. in four stomachs.
 Myriapoda, $\frac{1}{10}$ per cent. in one stomach.
 Arachnida, 1 per cent. in six stomachs.
 Vermes, $1\frac{1}{2}$ per cent. in twelve stomachs.
 Insecta, $97\frac{1}{8}$ per cent. in sixty stomachs.
 Beneficial, 25 per cent.
 Injurious, 17 per cent.
 Neutral, 58 per cent.

May.—The stomachs of the eighteen robins shot during this month show the proportion of insect food to be almost exactly the same as for April. The percentage of *Carabidæ* is slightly less, and that of *Scarabæidæ* more than three times greater than during April. There is a doubling in the ratio of *Coleoptera*, a great increase in *Heteroptera*, but a decided falling away in *Lepidoptera* noticeable in the food for May as compared with that of the previous month.

The general summary for May is:

Vegetable food, none.
 Mollusca, none.
 Vermes, 3 per cent. in five stomachs.
 Insecta, 97 per cent. in eighteen stomachs.
 Beneficial species, 43.8 per cent.
 Injurious species, 37.3 per cent.
 Neutral species, 18.9 per cent.

Jun.—One noticeable feature of this month is the great increase of vegetable food. Of the 49 stomachs examined, 44 contained fruit amounting to 54 per cent. of the entire food. Insects fall away from 97 per cent. to 43.06 per cent., found in 46 stomachs. But while the *Coleoptera* are reduced to one-third of the ratio for May and the *Scarabæidæ* are greatly diminished, the *Carabidæ* maintain nearly the same proportion.

The greater part of the 49 robins were shot in the Station gardens, where there was ample opportunity for them to secure the small fruits, berries and cherries, which form so large a part of the food. But since quite a number were killed far from any gardens, the results obtained do not, I believe, unfairly represent the robin's diet. Furthermore, it is interesting and important to know how his diet varies during the different seasons for the same locality. The considerable number, 2.94 per cent., of mollusks—small snails—is worthy of mention. These were found in the stomachs of five robins. The percentage of Lepidopterous larvæ is also rather large, including cut-worms, two walnut caterpillars (*Datana*

angusii) and one common brown caterpillar (*Pyrrharctia isabella*) which is sometimes injurious to garden vegetables.

The summary for the month is as follows:

Fruit, 54 per cent. in 44 stomachs.
 Mollusca, 2.94 per cent in 5 stomachs.
 Insects, 43.06 per cent. in 46 stomachs.
 Beneficial species, 66.97 per cent.
 Injurious species, 10.86 per cent.
 Neutral species, 22.17 per cent.

July.—Forty-five robins were shot during this month, 25 on the Station grounds, 12 at Westerville, in the same county, and 8 at Sugar Grove, in Fairfield county. The percentage of vegetal food reaches its maximum during this month (61.75 per cent). The ratio of insect food is in consequence proportionately reduced, the Diptera and Hemiptera showing the greatest decrease. The *Carabidæ* are, in proportion to the number of *Coleoptera*, as important an element of food as they were in June. The proportion of *Lepidoptera* remains about the same, while perhaps the most striking feature is the great increase of ants, which furnished 9.21 per cent. of the entire food for the month and were found in 15 stomachs. Prof. Forbes, in his work on the feeding habits of the robin, records a similar increase of ants for the month of June.

The general summary for July is:

Vegetable food, 61.75 per cent. in 38 stomachs.
 Mollusca, 5 per cent. in 1 stomach.
 Vermes, 1 per cent. in 2 stomachs.
 Crustacea, 5 per cent in 1 stomach.
 Myriapoda, 5 per cent. in 1 stomach.
 Arachnida, 5 per cent. in 1 stomach.
 Insecta, 35.25 per cent. in 42 stomachs.
 Beneficial species, 71.77 per cent.
 Injurious species, 14.23 per cent.
 Neutral species, 14.00 per cent.

August.—During this month the vegetal food drops away nearly one-half. There is a perceptible increase in worms, spiders, myriapods and crustaceans. The percentage of insects is considerably increased. Beetles are more than doubled; *Carabidæ* are doubled and *Scarabæidæ* quadrupled; *Diptera* and *Heteroptera* are present in slightly larger proportions; *Lepidoptera* were a little on the decrease, and ants were about half as numerous as during July. During August *Orthoptera* came into some importance and make up 6.875 per cent of the robin's food for the month. This percentage is mostly of the common species, *Melanoplus femur-rubrum*, the red-legged grasshopper, and *Dissosteia carolina*, a large grasshopper with yellow hind wings.

The general summary for the month is as follows:

Vegetable food, 38.085 per cent. in 10 stomachs.
 Crustacea, 1.375 per cent. in 1 stomach.
 Vermes, 2.062 per cent. in 1 stomach.
 Myriapoda, 2.062 per cent. in 2 stomachs.
 Arachnida, .7 per cent. in 1 stomach.
 Insecta, 55.716 per cent. in 15 stomachs.
 Beneficial species, 54.536 per cent.
 Injurious species, 13.825 per cent.
 Neutral species, 31.639 per cent.

September.—Only five robins were shot during this month. Three of these had eaten nothing but black cherries, one, black cherries and carabid beetles, and one, blackberries and a *Melanoplus femur-rubrum*, the red-legged grasshopper and the one that is often so very injurious to grass and grain. At this time of the year robins begin to congregare into flocks, and a large part of their food is vegetable, consisting of wild cherries, grapes, moon-seed, poke-berry, bitter-sweet (*Celastrus scandens*) and other fruits which have a nutritious portion. I shot two robins in October, 1890, whose stomachs contained nothing but the fruit of bitter-sweet. The robin does his share of scattering the seeds of various more or less troublesome plants, for the seeds of pulpy fruits, when taken with the fruits as food and afterwards voided in waste places and along fence rows, are usually left in very favorable places for growth. The germinative power of the seeds is very seldom injured by passing through the robin.

Since, on account of the small number shot during September, I have left this month out in making a general summary, each one may decide for himself whether the fact that the robin helps to distribute the plants above mentioned is to be considered as a point for or against the robin. But let it not be supposed that by eating the fruit of these plants the robin is in that measure an enemy to them; on the contrary he only serves to scatter them the more widely.

Birds are high livers. Their temperature is greater than that of mammals. They are extremely active, spending most of their time upon the wing. This unusual amount of muscular and nervous expenditure requires for its maintenance a correspondingly large amount of nourishment. It will readily be granted that those birds which take mostly insect food exercise no small influence upon the numbers of those insects on which they feed. So far as our observations go, the robin is almost wholly insectivorous during April and May. It should also be kept in mind that the robin is a species which throughout Ohio is abundant. While the larvæ of *Bibio albipennis* are to be found, they seem to be preferred to any other species of insect. Perhaps the reason for this is the fact that they

are usually found in clusters, so that the robin is able to make a meal very easily. To give some hint of what a voracious feeder the robin is, it is only necessary to say that from the stomach of a single robin I took 168 of these *Bibio* larvæ; and other observers have recorded a still larger number. Considering the abundance of the robin and the fact that this could not be more than half a day's food, it is easily seen how he must reduce the numbers of the insect. The robin readily adapts himself to varying circumstances, and seems always to choose that food which is most abundant and most easily procured. In March, when insects were difficult to obtain, he fed on the asparagus. When the *Bibio* larvæ became numerous, he took them in large numbers. When *Agonoderus* and the species of *Aphodius* became sufficiently abundant to attract his attention, they entered largely into his diet, and when the small fruits came he did not scruple to take his share—a very indefinite quantity. I should not neglect to say that in their season he fed to more or less extent upon wire-worms, cut-worms and May beetles.

A few words to call attention to the variety of insect and other food may not be out of place. In the stomachs examined were found caterpillars of all sorts, from the smooth Geometrids or Span-worms, and Noctuids (cut-worms) to the more hairy kinds, such as the walnut caterpillar, *Datana angusii*, and even the common brown caterpillar, *Pyrrharcia isabella*. Coleoptera of several families were noted, *Staphylinidæ*, *Dermestidæ*, *Curabidæ*, *Scarabæidæ*, *Lampyridæ*, *Eluteridæ*, *Otiorhynchidæ*, *Curculionidæ*, *Nitidulidæ*, *Chrysomelidæ* and *Buprestidæ*. There were found adult and pupal Hymenoptera, adult and larval Diptera, Coleoptera and Lepidoptera, adult and nymphal Heteroptera, Homoptera and Orthoptera, adult Neuroptera (Agrione, a small dragon fly), Arachnida (species of spiders), Mollusca (small snails of several species), Crustacea (sow-bugs) and Myriapoda. This large range of animal food, together with the fact that a great majority of the fruits, cultivated and uncultivated, which have a juicy nutritious portion, are included in the dietary of the robin, shows how nearly omnivorous he is in feeding habits.

In regard to the place and manner in which he searches for food, I have observed that he is a ground feeder. He may most often be seen on freshly plowed grounds, lawns, pastures, meadows, and in woodland searching for insects in the soil, grass or leaves. His vegetal food is taken from the plants on which it grows. But I have never seen the robin searching for insect food except upon the ground, and have not found any exclusively tree-feeding species of insects in the stomachs which I have examined, with the single exception of the larvæ of the Walnut Moth (*Datana angusii*), and even these were very probably taken by the robin while crawling on the ground. The robin does not follow the plow so

closely or so persistently as do some other species of birds, e. g., the Purple Grackle. While the last spring plowing was in progress I several times noticed the behavior of the robins on the plowed ground. They were to be seen scattered indiscriminately over the field, and not close behind the plow like the crow blackbirds. No white grubs were found in the robins shot at this time, although they were moderately plenty in the soil. They soon bury themselves in the soil again; hence the failure of the robin to find any.

When the robins first arrive in early spring, they feed in companies, later separate to pair, and in the fall gradually congregate again. The old and young do not always remain together. I noticed that during the fruit season the robins shot in the Station gardens were in the proportion of nine young to one old bird, and that the old birds took much more insect food than the young. While the young birds were feeding upon raspberries and other garden fruits, the old birds might be found more abundantly on newly mown meadows or in woodland. In fact two old robins shot in the berry patch had taken no fruit of any kind, but were well filled with insect food. No one would naturally suppose that there were so many robins in a limited locality as appear in the cherry orchards and berry patches when the fruit begins to ripen. The young remain close by the fruit during the whole season, but the old robins soon set out for other feeding grounds, as above indicated, or at most come to the fruit for only a small portion of each day.

Although no stomachs of nestlings were examined, the old birds have been several times shot while carrying earth-worms, spiders, caterpillars, carabid beetles and moths in their bills. These food matters were evidently intended to be fed to their young, since robins do not have the habit of carrying food about to be eaten by themselves afterwards. In the cases just mentioned the insects were but slightly injured. So far as I can judge from observation, the old birds do not carry fruit to the young while still in the nest, although they introduce them to it as soon as they can fly. One old bird was shot while carrying a caterpillar and a moth to its young, but nothing was found in her stomach except raspberries.

A general summary of the results obtained may be tabulated as follows:

[illegible]

Food.	April.		May.		June.		July.		August.		Total.	
	No. birds examined.	Per cent. food.	No. birds examined.	Per cent. food.	No. birds examined.	Per cent. food.	No. birds examined.	Per cent. food.	No. birds examined.	Per cent. food.	No. birds examined.	Per cent. food.
<i>Halicta</i>	3	.8	.....	.....	.....	.....	.....	.....	.....	.....	3	.2
<i>Dionycha</i>	2	.3	.....	.....	.....	.....	.....	.....	.....	.....	2	.06
<i>Chrysomela, similis</i>...	.....	.....	.....	.....	1	.2	.....	.....	.....	.....	1	.04
<i>Luperus thoracicus</i>.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.04
<i>Rhyncophora</i>	4	.4	.....	.....	15	6.6	1	.2	.....	.....	35	4.8
<i>Otiorynchidae</i>	3	.3	.....	.....	1	.2	8	2.1	.....	.....	10	1.1
<i>Curculionidae</i>	1	.1	.....	.....	14	6.3	3	.9	.....	.....	25	3.7
<i>Hymenoptera</i>	8	2.8	.....	.....	8	2.5	16	9.4	.....	.....	36	3.8
<i>Formicidae</i>	4	.8	.....	.....	.....	.....	15	9.2	.....	.....	23	2.9
<i>Tenthredinidae</i>.....	.....	.....	.....	.....	1	.7	.....	.....	.....	.....	1	.1
<i>Vespidæ</i>.....	.....	.....	.....	.....	.....	.....	1	.2	.....	.....	1	.04
<i>Total insects</i>	60	97.7	18	97	46	43	42	35.2	15	55.7	181	65.6
<i>Mollusca</i>.....	.....	.....	.....	.....	5	3	1	.5	.....	.....	6	.7
<i>Vermes (earth-worms)</i>	12	1.3	5	3	.....	.....	2	1	.....	.....	20	1.5
<i>Myriapods</i>	1	.1	.....	.....	.....	.....	1	.5	.....	.....	4	.5
<i>Crustacea (sow-bugs)</i>.....	.....	.....	.....	.....	.....	.....	1	.5	.....	.....	2	.4
<i>Arachnida (spiders)</i>	6	.1	.....	.....	.....	.....	1	.5	.....	.....	8	.4
<i>Summary.</i>												
Beneficial species.....	.....	25	.....	44	.....	67	.....	72	.....	54.5	.....	52.4
Injurious species.....	.....	17	.....	37.3	.....	10.9	.....	14.2	.....	13.8	.....	18.6
Neutral species.....	.....	58	.....	19	.....	22.2	.....	14	.....	31.6	.....	28.9
Number birds examined.....	60	.....	18	.....	49	.....	45	.....	15	.....	187	.....

In the above table is given the percentage of each particular article of diet in the whole food for each month, and the number of robins which were found to have eaten the particular food during the month. The last two columns indicate the average monthly proportion of the various food matters for the whole five months, and the total number of robins which had taken each food matter during that time. At the end of the table is given the economic proportion for each month, and in the last column the average monthly proportion for the entire time.

It will be seen that this last proportion indicates the robin's food to consist, on the average, of 52 per cent. of species, plants and insects, which are beneficial to us, of about 19 per cent. which are injurious, and of 29 per cent. whose economic relations are not known.

The question now is, what shall we do with the robin in the light of these results? There are so many things to consider. The reactions of different organisms upon one another are so varied, complex and far-reaching that it is almost impossible to say what would be the effect upon the whole biological realm of dropping out one species. But even allowing for the possibility that, as Prof. Forbes thinks, the services of the predacious beetles which the robin destroys have been overestimated, yet it seems that we may justly urge from the results set forth above, that the fruit grower should at least be allowed to kill the robin during the season when he is most harmful, and not, as at present, be in danger of arrest and fines for shooting the robins in his own gardens.

The robin may be a pleasant singer and may possess commendable domestic habits. He destroys cut-worms and white grubs. But let us not imagine that all his insect food is of an injurious nature, and let us not, while praising the robin for the good he does, forget his faults, which are many.

REMARKS BY THE HORTICULTURIST.

The robin has generally been regarded as more useful than injurious. It is true that an occasional fruit grower has dissented from the view held by the majority, and has felt inclined to take the law into his own hands and protect his crops with a shot gun, but until recent years the robin has been allowed to exact whatever tribute of fruit he wished without much fear of molestation.

Small fruits are more largely grown than formerly, while wild fruits are less abundant, but the robin's appetite has not changed, nor do his numbers seem to be lessened; indeed, many believe that the reverse is true. At any rate many are beginning to think that whatever value the

services of the robin may have to the public in general, the tribute that he exacts in berries is too great for berry growers to bear alone.

The capacity of the robin for berries is enormous, and when hundreds come at once the grower suffers serious losses. On the Station grounds nearly all of the early raspberries and blackberries are taken by robins, and only in the height of the season are there enough berries left to give the pickers a chance to earn fair wages. If left to themselves the robins would take the greater share of the black raspberries that grow on a plantation of more than an acre. Growers in other parts of the country have complained of losses quite as large. This has turned the sentiment of many berry growers against the robin. Many who formerly upheld the robin are now forced to admit that the good that he does is paid for at a very high price, and not always by those who can afford the tax.

There is, however, no unanimity of opinion as to what should be done. Some would have the robin no longer protected by law, at least allowing every man the right to guard his own premises in the best manner that he can; others would keep the law in force and permit no one to shoot the robin. The latter class seem to be in the majority, as an effort made two years ago to have the law repealed failed because of the sentiment in favor of the robin.

The investigations described in the preceding paper were undertaken in order that fruit-growers may act more intelligently, both in regard to securing proper laws, and in their dealings with the robin on their own premises. The literature on the subject was not very full, nor generally accessible, and there seemed to be abundant reason for opening up the subject again. It was not expected that the matter would be settled pro or con—for it was well known that there are two sides to the question—but it was hoped that more knowledge of the food habits of the robin, added to what is already known, would serve to show what course of action should be taken by those interested. The evidence shows that the robin is useful, but his services are not so great that they may not be overpaid. When the fruit-grower becomes aware that the robin is overreaching him there ought to be no question as to the legality of defending one's own premises. There is no occasion to attempt the extermination of the robin, but there does seem to be good reason for trying to keep it in check, even though sentiment pleads the contrary course. If fruit-growers choose to secure legislative action favorable to themselves, regarding the robin, the facts in the case would seem to bear them out in doing so.

Mr. Wilcox deserves credit for the painstaking manner in which he has carried out the work, and for fairness and clearness in presentation of the facts. Errors in determination are, as he states, unavoidable, but

these could hardly be sufficient in number nor of such a character as to affect the general results.

Since these investigations were undertaken largely from the fruit-growers' standpoint it has been suggested that possibly where fruit is not so abundant as in this locality, where the robins were shot, the results do not show the agricultural as well as the horticultural phases of the question. Consequently some robins were shot in meadows in the spring of 1892 by Mr. J. S. Hine, and examinations made by Prof. Webster, who reports the results below :

CRANE FLIES (*Tipuliæ*) AS FOOD OF THE ROBIN.

BY F. M. WEBSTER.

These are large, slender bodied flies, with very long legs, and are sometimes called "Gallinippers." In England their larvæ or maggots are known as "leather jackets." There, too, they prove a serious pest of the wheat fields, especially in ground following clover. In this country they are only just coming into notice as farm pests, but some of our species bid fair to rival their English congeners in their work of destruction, affecting not only wheat, on new ground, but clover and grass lands as well.

During the spring of 1892 fourteen robins were shot, on various dates and in different localities about Columbus. In some of these fields we knew the larvæ of crane flies to be very abundant; but, of the whole number of robins shot, but three had eaten crane fly larvæ, as shown by an examination of the stomachs. Of these, one had evidently made a full meal from this food. We did not find in the food partaken of by the whole series a trace of an adult; yet it is known that they do, sometimes at least, devour the adults, as eggs have been found in their stomachs in Illinois.

As the robin is a constant visitor of the grass lands in spring, it was hoped that in them we might find a useful servant in destroying this pest, but our investigations, which seem to us to have been both careful and judicious, did not fulfill our hopes in that direction. Robins get from the grass lands, in April and May, a very large per cent. of their food, but it has, so far, proven to consist for the most part of insects of whose destructive propensities we have as yet no proof, while the crane flies, which we do know to be injurious, are, even when abundant, eaten only sparingly.

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